

Superfund Program Proposed Plan

U.S. Environmental Protection Agency Region 2

Maunabo Groundwater Contamination Superfund Site Maunabo, Puerto Rico August 2012



INTRODUCTION

This Proposed Plan (Plan) identifies the Preferred Alternative for cleaning up the contaminated groundwater at the Maunabo Area Groundwater Contamination Superfund Site (Site), Maunabo, Puerto Rico (Figure 1) and provides the rationale for this preference. In addition, this Plan includes summaries of other cleanup alternatives evaluated for use at this Site. This document is issued by the U.S. Environmental Protection Agency (EPA), the lead agency for Site activities, and the Puerto Rico Environmental Quality Board (EQB), the support agency. EPA, in consultation with EQB, will select a final remedy for the Site after reviewing and considering all information submitted during the 30-day public comment period. EPA, in consultation with EQB, may modify the Preferred Alternative or select another response action presented in this Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the alternatives presented in this plan.

The U.S. Environmental Protection Agency (EPA) is issuing this Proposed Plan as part of its requirements under Section 117(a) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, commonly known as Superfund), and Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan.

This Proposed Plan summarizes information that can be found in greater detail in the Remedial Investigation and Feasibility Study (RI/FS) reports and other documents contained in the Administrative Record (AR) for this Site. EPA and EQB encourage the public to review these documents to gain a more comprehensive understanding of the Site and Superfund activities that have been conducted there.

SITE BACKGROUND

The Maunabo Urbano public water system consists of four groundwater wells: Maunabo #1 through Maunabo #4. This system serves a population of approximately 14,000 people and is managed by the Puerto Rico Aqueduct and Sewer Authority (PRASA). In 1961, PRASA installed the public water supply well Maunabo #1 and it was used until 1974 (Adolphson et al. 1977).

In 2001, PRASA decided to reactivate the Maunabo #1 well. In 2002, PRASA conducted groundwater sampling which found the presence of chlorinated volatile organic compounds (VOCs), tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and 1-dichloroethene (1,1-DCE). The maximum



MARK YOUR CALENDAR

PUBLIC COMMENT PERIOD:

August 9, 2012 – September 7, 2012

EPA will accept written comments on the Proposed Plan during the public comment period.

Written comments should be addressed to:

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PUBLIC MEETING:

August 23, 2012 at 7:00 pm

EPA will hold a public meeting to explain the Proposed Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held at the Maunabo City Hall.

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concentrations of PCE, TCE, and cis-1,2-DCE detected in Maunabo #1 were 16.4 micrograms per liter (µg/L), 1.6 µg/L, and 4.3 µg/L, respectively. The federal maximum contaminant level (MCL) for PCE and TCE is 5 µg/L, and for cis-1,2-DCE is 70 µg/L. In addition, Maunabo #2, #3, and #4 wells were sampled to determine the presence of VOCs. Another VOC, 1,1-dichloroethene (1,1-DCE) was detected intermittently in subsequent years in both Maunabo #1 and Maunabo #4 at levels below the MCL. These VOCs were not present in samples collected from Maunabo supply wells #2 and #3 over the same time period. Tap water samples of the distributed water showed that the contaminants detected in Maunabo #1 were present.

In March 2002, the Puerto Rico Department of Health (PRDOH) ordered PRASA to close Maunabo #1 because the PCE concentration exceeded the federal MCL. However, rather than close the well, PRASA opted to treat the groundwater at the wellhead using activated carbon filtration tanks. Post-treatment samples taken as part of a PRDOH 2004 inspection, including tap water samples collected from the distribution system down the line from Maunabo #1, indicated that PRASA's treatment was not effective and that contaminated drinking water was reaching the consumers.

In October 2005, EPA's Site Assessment Team (SAT) 2 collected water samples from Maunabo Wells #1, #2, #3, and #4, and in the distribution water system. The samples were analyzed for Target Compound List (TCL) organic parameters, base/neutral/acid, pesticides/polychlorinated biphenyls (PCBs) and Target Analyte List inorganic parameters including mercury and cyanide through the EPA Contract Laboratory Program (CLP).

The data confirmed the presence of PCE and cis-1,2-DCE in Maunabo #1 and in post-treatment samples along the distribution line at levels below the MCLs. The results also confirmed the presence of 1,1 DCE in Maunabo #4 and a gasoline additive, methyltertbutylether (MTBE), in Maunabo #1 and in the distribution system samples. No detections were above the MCL, except for bis(2-ethylhexyl) phthalate (6.5 µg/L) in Maunabo #3, which marginally exceeded the MCL of 6 µg/L. PCE, cis-1,2-DCE, 1,1-DCE, and MTBE were not detected in Maunabo #2 and Maunabo #3.

In December 2005, SAT 2 conducted a limited investigation to identify possible sources of groundwater contamination in Maunabo. Facilities that were investigated include the former Maunabo Municipal Solid Waste Land-

fill (Maunabo Landfill), PRASA's Wastewater Treatment Plant located close to Maunabo Well #1, El Negro Auto Body/Parts Shop, Total Gas Station, Esso Gas Station, and five light industrial facilities operating under the auspices of the Puerto Rico Industrial Development Corporation (PRIDCO). The five identified PRIDCO industrial facilities are: Centro de Acopio Manufacturing; Juan Orozco Limited, Inc; Puerto Rico Beverage; FEMA Storage Facility; and Plastic Home Products.

A summary of SAT 2 limited investigation activities and findings is presented below. All of the samples collected at the properties described below were analyzed for target compound list (TCL) VOCs through the EPA contract laboratory program (CLP).

- **Maunabo Landfill** - SAT 2 collected four surface soil samples, including one duplicate, one subsurface soil sample, and one groundwater sample at the former Maunabo Landfill. VOCs were not detected in the samples. No preliminary assessment/site inspection (PA/SI) report was prepared by SAT 2 for the landfill.
- **PRASA Wastewater Treatment Plant** - SAT 2 collected four surface soil samples, two subsurface soil samples, and one groundwater sample at the PRASA Wastewater Treatment Plant. VOCs were not detected in the samples. No PA/SI report was prepared for this facility.
- **El Negro Auto Body/Parts Shop** - SAT 2 conducted an on-site reconnaissance of the facility. The facility was well maintained. One surface soil sample was collected from an open area adjacent to the facility. VOCs were not detected in the sample. SAT 2 had no detailed information regarding historical waste disposal practices at the facility. The PA/SI report for the facility recommended no further remedial action.
- **Total Gas Station** - SAT 2 collected two groundwater samples at the Total Gas Station. MTBE, a gasoline additive, was detected at 14 and 7J µg/L in the samples Benzene was detected at 4J µg/L and 20 µg/L, which exceeded the MCL of 5 µg/L. SAT 2 did not prepare a PA/SI report for this facility.
- **Esso Gas Station** - SAT 2 collected three groundwater samples, including one duplicate, at the Esso Gas Station. No VOCs were detected in the samples. No PA/SI report was prepared for this facility.
- **Centro de Acopio Manufacturing** - SAT 2 collected four surface soil samples, two subsurface

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soil samples, and one groundwater sample from open areas adjacent to the Centro Acopio Manufacturing (CAM) facility building using the Geoprobe™ direct-push method. No VOCs were detected in the samples. A review of available background information indicated that these substances were not generated by activities at the CAM facility, nor were any waste sources suspected of releasing or having the potential to release contaminants to groundwater or surface water identified at the CAM facility. The PA/SI report recommended no further remedial action for the CAM facility.

- **Juan Orozco Limited, Inc.** - SAT 2 collected four surface soil samples, two subsurface soil samples, and one groundwater sample from open areas adjacent to the facility building using the Geoprobe™ direct-push method. Analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells as well as the remaining VOC parameters. A review of available background information indicated that these substances were not generated by activities at Juan Orozco Limited, nor were any waste sources suspected of releasing or having the potential to release contaminants to groundwater or surface water identified at the facility. The PA/SI report recommended no further remedial action.
- **Puerto Rico Beverage** - SAT 2 collected four surface soil samples, two subsurface soil samples, and one groundwater sample from open areas adjacent to the Puerto Rico Beverage (PRB) facility building using the Geoprobe™ direct-push method. No VOCs were detected in the samples. A review of available background information indicated that VOCs were not generated by activities at PRB, nor were any waste sources suspected of releasing or having the potential to release to groundwater or surface water identified at the PRB facility. The PA/SI report recommended no further remedial action for PRB.
- **FEMA Storage Facility** - SAT 2 collected five surface soil samples, including a duplicate sample, and two subsurface soil samples from open areas adjacent to the FEMA Storage Facility using the Geoprobe™ direct-push method. No VOCs were detected in the samples.
- **Plastic Home Products** - SAT 2 collected four surface soil samples and two subsurface soil samples from open areas adjacent to the Plastic

Home Products (PHP) facility using the Geoprobe™ direct-push method. No VOCs were detected in the samples. A review of available background information indicated that VOCs were not generated by activities at PHP, nor were any waste sources suspected of releasing or having the potential to release contaminants to groundwater or surface water identified at the PHP facility. The PA/SI report recommended no further remedial action for PHP.

SAT 2 collected four background surface soil, two background subsurface soil, and one background groundwater sample. No VOCs were detected in the background samples. Based on the October and December 2005 data, SAT 2 concluded that there was insufficient information to determine the source of contamination of the public supply wells.

EPA completed a Hazard Ranking System Documentation Package (HRS) in 2006. The Site was listed on the National Priorities List (NPL) on September 27, 2006.

EPA conducted a Remedial Investigation (RI) at the Site from August 2010 to July 2011. From August 25 through September 29, 2010, a groundwater screening investigation was conducted at five potential source areas based on information provided in the Site Inspection and Hazard Ranking System Report and a field reconnaissance conducted by CDM Smith. The groundwater screening investigation was conducted to provide screening-level data on the distribution of VOCs in groundwater. The screening data were used to support selection of the locations and depths of permanent monitoring wells and to identify potential source areas for subsequent soil sampling. Groundwater screening investigation samples were collected along four transects (Figure 2):

- Transect 1 – East - Potential Source Area Upgradient of Maunabo # 4
- Transect 1- West - PRIDCO Potential Source Area (including Puerto Rico Beverage [PRB])
- Transect 2 - Central Potential Source Area
- Transect 3 - Northern Potential Source Area
- Transect 4 - Former Sugar Mill Potential Source Area

Groundwater screening samples were collected along four transects oriented approximately perpendicular to the estimated groundwater flow direction. Groundwater screening samples were collected using a groundwater sampling system with a 4-foot screen attached to a direct push technology. At each location, samples were collect-

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ed at 10-foot intervals, starting from the bottom of borehole and extending to the groundwater table. All screening samples were analyzed for trace-level VOCs with a 24-hour turnaround time.

A summary of the groundwater screening collected from the five source areas is provided below:

- **Transect 1 – East - Southeastern Potential Source Area** - A total of 37 groundwater screening samples, including duplicates, were collected from four locations downgradient from a residential/commercial area and upgradient of Maunabo #4.
- **Transect 1 – West - PRIDCO Potential Source Area** - A total of 71 groundwater screening samples, including duplicates, were collected from 10 locations downgradient from Centro de Acopio, Juan Orozco LTD, PRB and PRASA's Waste Water Treatment Plant.
- **Transect 2 - Central Potential Source Area** - A total of 10 groundwater screening samples, including duplicates, were collected from four locations downgradient of the Esso Gas Station and Maunabo Dry Cleaners.
- **Transect 3 - Northern Potential Source Area** - A total of 12 groundwater screening samples, including duplicates, were collected from four locations downgradient from the Federal Emergency Management Agency (FEMA) Storage Facility, Plastic Home Products, and Total Gas Station.
- **Transect 4 - Former Sugar Mill (FSM) Potential Source Area** - A total of 31 groundwater screening samples, including duplicates, were collected from four locations downgradient from the FSM facility, south of the Rio Maunabo.

From December 10 through 22, 2010, 64 additional groundwater screening samples, including duplicates, were collected and analyzed for VOCs. This groundwater screening supplemental sampling was conducted at nine additional locations. These additional locations were added to provide the data to refine and focus the locations and depths for permanent monitoring wells, including background monitoring wells.

Three groundwater monitoring wells were used to evaluate water quality upgradient of the impacted areas. Sediment and surface water background samples were collected upriver from the expected zone of impact in the Rio Maunabo.

A total of 16 monitoring wells were installed as part of the RI. Two rounds of groundwater samples were collected from the 16 monitoring wells and the four public supply wells (Maunabo# 1 through Maunabo# 4). Round 1 was conducted between March 2 and 8, 2011. Round 2 was conducted between June 7 and 10, 2011. During the RI field investigation, groundwater background samples were collected from areas not expected to be impacted by site-related contamination. These samples were analyzed for the same analytical parameters as previous sampling events.

Based on the groundwater data collected during the RI, there are three separate plumes (cis-1,2-DCE, PCE, and 1,1,-DCE) at the Site (Figure 3). The plumes are located in different areas of the Site and have characteristic contaminant profiles. The conclusions for each of the three plumes are:

Cis-1,2-DCE Plume - The configuration of this plume indicates that a release of site-related contaminants, most likely PCE or TCE, occurred in or near the Puerto Rico Beverage (PRB) facility. Cis-1,2-DCE, a degradation product of TCE, was found at the highest concentrations (up to 300 µg/L) in this area. Related VOCs including trans-1,2-DCE, 1,1-DCE, and vinyl chloride (VC) are also present, but at much lower concentrations. Only cis-1,2-DCE (up to 300 µg/L) and VC (up to 1.8 µg/L) exceed the groundwater screening criteria. Site-related groundwater contamination was not detected in groundwater upgradient of the PRB Area. The plume is migrating toward the southwest, influenced by pumping at the Maunabo #1 supply well and groundwater flow toward the Rio Maunabo.

PCE Plume – The primary contaminant in this plume near the Former Sugar Mill is PCE, which is present at concentrations exceeding screening criteria in one monitoring well (8.5 µg/L) and one screening location (7.4 µg/L). TCE was also detected, but concentrations were well below the screening criteria of 5 µg/L. The plume is migrating toward the northeast, influenced by pumping at the Maunabo #1 supply well and groundwater flow toward the Rio Maunabo. The downgradient edge of the plume is the Maunabo #1 supply well.

1,1,-DCE Plume – This plume is located northwest of Maunabo #4 and differs from other plumes in that it consists almost entirely of 1,1-DCE. The highest concentration of 1,1-DCE detected was 25 µg/L in a monitoring well (MW-L). Also, 1,1-DCE was detected in the Maunabo #4 supply well (1.1 µg/L). The plume appears

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to be migrating toward the southeast, toward Maunabo #4. However, the plume may also be migrating toward the southwest, influenced by groundwater flow toward the Rio Maunabo. The source of this plume is unknown.

Surface and subsurface soil samples were collected at two potential source areas, the PRB Area and FSM Area. These areas were identified as potential source areas based on the groundwater screening results. A discussion of the results of the soil sampling is as follows:

PRB Area – Surface and subsurface soil samples collected from the PRB Area did not identify a source of site-related VOCs. None of the six site-related VOCs was detected in soil samples from the PRB Area. However, one Semi-Volatile Organic Compound (SVOC), bis(2-ethylhexyl)phthalate, and several metals exceeded screening criteria. The SVOC and metals are not considered to be site-related and are not affecting the public supply wells.

FSM Area – Surface and subsurface soil samples collected from the FSM Area did not identify a source of site-related VOCs. None of the six site-related VOCs were detected in soil samples from the FSM Area. However, in surface soil samples, three SVOCs and 12 metals exceeded screening criteria, and one SVOC, benzo(a)pyrene, and eight metals exceeded their screening criteria in subsurface samples. The SVOC and metals are not considered to be site-related and are not affecting the public supply wells.

Surface water, sediment, and porewater have not been impacted at the site since none of the six site-related VOCs was detected samples collected from these media in the Rio Maunabo. No VOCs, SVOCS, pesticides, PCBs, or metals exceeded screening criteria in surface water or porewater samples. Six metals exceeded screening criteria in sediment samples, but they are not considered to be site-related.

SITE CHARACTERISTICS

The Site is located in the municipality of Maunabo, in the southeastern coastal area of Puerto Rico (18° 00' 20.6" north latitude and 65° 54' 19.5" west longitude), within an isolated alluvial river valley (Figure 1). It is surrounded by mountains to the north, east, and west and the Caribbean Sea to the southeast. The highest point in the area is Cerro La Pandura at 1,700 feet above mean sea level (amsl) and the lowest point is the Caribbean Sea to the southeast. The Maunabo River and several intermittent streams are located in the vicinity of the Site and flow to the southeast toward the Caribbean Sea. The area topography slopes south/southwest from the nearby hills, approximately 180 feet amsl, toward the Maunabo River at 30 feet amsl. The elevation of the Site area is approximately 40 feet amsl. The limits of the Pandura Sierra Mountain Range run through the north and northeast region of Maunabo, in which the Pandura and El Sombrerito hills, at the border with Yabucoa, are the highest elevations. With the exception of the elevations noted above, the rest of the territory of Maunabo is quite level. As a result, it is geographically considered part of the Southern Coastal Valley.

The Site consists of three groundwater plumes (cis-1,2-DCE; PCE; and 1,1,-DCE) with no identified source(s) of contamination (Figure 3). The Maunabo Urbano public water system consists of four groundwater wells: Maunabo #1 through Maunabo #4. Groundwater contamination was found in two of the public supply wells, Maunabo #1 and Maunabo #4. The four public supply wells are completed at depths ranging from 80 to 125 feet below the ground surface (bgs) in the Maunabo alluvial valley aquifer. This aquifer generally consists of poorly sorted sand, silt, clay, and gravel alluvium, including lenticular deposits of sand, gravel, and cobbles.

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The administrative record file, which contains the information upon which the selection of the response action will be based, is available at the following locations:

Maunabo City Hall
Maunabo, PR
(787) 861-1012
Hours: Monday – Friday 9:00am to 3:00 pm

USEPA-Caribbean Environmental Protection Division
City View Plaza II – Suite 7000
48 RD. 165 Km. 1.2
Guaynabo, P.R. 00968-8069
(787) 977-5865
Hours: Mon - Fri 9:00 a.m. to 5:00 p.m.
By appointment

Puerto Rico Environmental Quality Board
Emergency Response and Superfund Program
Edificio de Agencias Ambientales Cruz A. Matos
Urbanización San José Industrial Park
1375 Avenida Ponce de León
San Juan, PR 00926-2604
(787)767-8181 ext. 3207
Hours: Monday – Friday 9:00am to 3:00 pm
By appointment

U.S. EPA Records Center, Region 2
290 Broadway, 18th Floor.
New York, New York 10007-1866
(212) 637-4308
Hours: Monday-Friday - 9 am to 5 pm
By appointment.

The regional direction of groundwater flow in the Maunabo basin is to the southeast toward the Caribbean Sea. Wellhead Protection Areas are delineated for the public supply wells, so the groundwater plumes lie within a designated Wellhead Protection Area.

SCOPE AND ROLE OF THE ACTION

Groundwater contamination has been defined in sufficient detail to complete the RI Report and prepare a feasibility study and risk assessments.

SUMMARY OF SITE RISKS

As part of the Remedial Investigation and Feasibility Study, EPA conducted a baseline risk assessment to determine the current and future effects of contaminants on human health and the environment. The current exposure pathways and receptors evaluated are: Commercial Industrial Workers at Former Sugar Mill and Puerto Rico Beverage; Trespassers at Former Sugar Mill and Puerto Rico

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these under current- and future-land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the contaminants of concern at the site in various media (i.e., soil, groundwater, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil. Factors relating to the exposure assessment include, but are not limited to, the concentrations that people might be exposed to and the potential frequency and duration of exposure. Using these factors, a “reasonable maximum exposure” scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of adverse effects (response) are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other non-cancer health effects, such as changes in the normal functions of organs within the body (e.g., changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and non-cancer health effects.

Risk Characterization: This step summarizes and combines exposure information and toxicity assessments to provide a quantitative assessment of site risks. Exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means an “one-in-ten-thousand excess cancer risk”; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions explained in the Exposure Assessment. Current Superfund guidelines for acceptable exposures are an individual lifetime excess cancer risk in the range of 10^{-4} to 10^{-6} (corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk). For non-cancer health effects, a “hazard index” (HI) is calculated. An HI represents the sum of the individual exposure levels compared to their corresponding reference doses. The key concept for a non-cancer HI is that a “threshold level” (measured as an HI of less than 1) exists below which non-cancer health effects are not expected to occur.

Beverage; Residents at Former Sugar Mill; and Recreational Users at Maunabo River. The future exposure

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pathways and receptors evaluated are: Commercial Industrial Workers at Former Sugar Mill and Puerto Rico Beverage; Trespassers at Former Sugar Mill and Puerto Rico Beverage; Residents at Former Sugar Mill, Puerto Rico Beverage, and Maunabo River; Recreational Users at Maunabo River; and Construction Workers at Former Sugar Mill and Puerto Rico Beverage. In addition, the potential future use of groundwater will be as a drinking water source for the community once safe cleanup levels have been achieved. Hence, the baseline risk assessment focused on health effect for both children and adults, in a residential setting, that could result from current and future direct contact with: (1) contaminated soil (e.g., children ingesting soil); and (2) contaminated groundwater (e.g., through ingestion and inhalation of volatile compounds). It is the lead agency's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other alternatives considered in the Proposed Plan, is necessary to protect human health or welfare or the environment for actual or threatened releases of hazardous substances into the environment.

Human Health Risk Assessment

The chemicals of potential concerns (COPCs) identified for the Site are based on criteria outlined in the Risk Assessment Guidance for Superfund, primarily through comparison to risk-based screening levels.

Two semi-volatile organic compounds (benzo(a)pyrene and dibenzo(a,h)anthracene) and eight inorganics (aluminum, arsenic, chromium, cobalt, iron, manganese, thallium, and vanadium) are identified as COPCs in the surface and subsurface soil at the Former Sugar Mill area.

Seven (aluminum, arsenic, chromium, cobalt, iron, manganese, and vanadium) inorganics are identified as COPCs in the surface and subsurface soil at the Puerto Rico Beverage area.

Five volatile organic compounds (cis-1,2-dichloroethene, tetrachloroethane, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride) and nine inorganics (aluminum, arsenic, barium, chromium, cobalt, copper, iron, manganese, and vanadium) are identified as COPCs in the groundwater.

Two VOCs (bromodichloromethane and dibromochloromethane) and six inorganics (arsenic, chromium, cobalt, iron, manganese, and vanadium) are identified as COPCs in sediment from the Maunabo River.

Exposure pathways evaluated for soil include ingestion of and dermal contact with soil, inhalation of particulates from soil by commercial/industrial workers, trespassers, residents, and construction workers. Exposure pathways evaluated for groundwater include ingestion of and dermal contact with groundwater, inhalation of vapor released during showering and bathing, and inhalation of vapor through vapor intrusion by commercial/industrial workers and residents. Exposure pathways evaluated for surface water and sediment include ingestion of and dermal contact by recreational users.

For the current and future land-use scenarios, total estimated cancer risks are within EPA's target range (cancer risk of 1×10^{-6} to 1×10^{-4}) for all receptors under the Reasonable Maximum Exposure (RME) scenario, except residents at both the Former Sugar Mill and Puerto Rico Beverage areas. The risks are driven by the potential exposure to groundwater as a potable water supply. However, under the Central Tendency Exposure (CTE) scenario, the total cancer risks are within EPA's target range of 1×10^{-6} to 1×10^{-4} .

For the current and future land-use scenarios, total non-cancer health hazards are within EPA's target threshold (Hazard Index of 1.0) for all receptors under the RME scenario, except commercial and industrial workers, construction workers, and residents at both the Former Sugar Mill and Puerto Rico Beverage areas. The current and future commercial/industrial workers, construction workers, and residents have non-cancer Hazard Index (HI) exceeding EPA's threshold of unity under the RME scenario for the kidney, respiratory system, lung, and gastrointestinal (GI) tract. Non-cancer health hazards for current and future commercial/industrial workers and construction workers are almost entirely due to the hypothetical use of contaminated groundwater as a potable water supply. For current and future residents, the potential health hazards to the kidney are results of exposure of cis-1,2-DCE and vanadium in groundwater, while the potential adverse health effects to the respiratory system are results of exposure to vanadium in soil and groundwater. The potential adverse health effects to the lung and GI tract are mainly results of exposure to arsenic and iron, respectively, in both soil and groundwater. Under the CTE scenario, the HIs still exceed EPA's threshold of unity for the same target organs/effects, except lung and GI tract, affected under the RME.

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**Cancer Risk Scenarios
(Current Scenario)**

Scenario	Area	Risk
Commercial Industrial Workers	Former Sugar Mill	4×10^{-5}
	PR Beverage	4×10^{-5}
Trespassers	Former Sugar Mill	9×10^{-7}
	PR Beverage	1×10^{-6}
Residents	Former Sugar Mill	2×10^{-4} (RME) 8×10^{-5} (CTE)
	Maunabo River	9×10^{-7}

**Cancer Risk Scenarios
(Future Scenario)**

Scenario	Area	Risk
Residents	PR Beverage	2×10^{-4} (RME) 8×10^{-5} (CTE)
	Maunabo River	2×10^{-5}
Future Construction Workers	Former Sugar Mill	2×10^{-7}
	PR Beverage	8×10^{-8}

**Non-Cancer Health Hazard Scenarios
(Current Scenario)**

Scenario	Area	Hazard Index
Commercial Industrial Workers	Former Sugar Mill	Total: 5 (RME) Kidney: 5 Respiratory System: 4
	PR Beverage	Total: 4 (CTE) Kidney: 3 Respiratory System: 3
		Total: 5 (RME) Kidney: 4 Respiratory System: 4
		Total: 3 (CTE) Kidney: 3 Respiratory System: 3
Trespasser	Former Sugar Mill	Total: 0.8
	PR Beverage	Total: 0.7
Residents	Former Sugar Mill	Total: 36 (RME) Kidney: 32 Respiratory System: 30 Lung: 2 GI* Tract: 2
		Total: 16 (CTE) Kidney: 14 Respiratory System: 13
Recreational Users	Maunabo River	Total: 1

* GI = Gastrointestinal

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Non-Cancer Health Hazard Scenarios (Future Scenario)

Scenario	Area	Hazard Index
Residents	PR Beverage	Total: 34 (RME) Kidney: 31 Respiratory System: 4 Lung: 2 GI* Tract: 2 Total: 15 (CTE) Kidney: 13 Respiratory System: 13
	Maunabo River	Total: 0.007
Construction Workers	Former Sugar Mill	Total: 2 Kidney: 2 Respiratory System: 2
	PR Beverage	Total: 2 Kidney: 2 Respiratory System: 2

* GI = Gastrointestinal

The vapor intrusion pathway was also evaluated. This exposure pathway was evaluated by performing a screening evaluation in order to determine if this exposure pathway is complete. Several contaminant concentrations exceeded their respective criteria. However, further evaluation identified that these exceedances were either located more than 100 feet away from any nearby residences or at a depth where an uncontaminated groundwater layer is above the contaminated groundwater. Considering the multiple lines of evidence, it was determined that vapor intrusion is currently not a concern.

Screening Level Ecological Risk Assessment

A screening-level ecological risk assessment (SLERA) was conducted to evaluate the potential for ecological risks from the presence of contaminants in surface soil, sediment, pore water and surface water. The SLERA focused on evaluating the potential for impacts to sensitive ecological receptors to site-related constituents of concern through exposure to soil, sediment, pore water and surface water. Concentrations of compounds detected in surface soil, sediment, pore water and surface water were compared to ecological screening values as an indicator of the potential for adverse effects to ecological receptors.

A complete summary of all exposure scenarios can be found in the SLERA Report, which is part of the Administrative Record for this Site.

Based on a comparison of maximum detected concentrations of contaminants in site soil, sediment, pore water and surface water, to conservatively derived Ecological Screening Levels (ESLs), the potential for ecological risk may occur. The chemicals of potential concern (COPCs) identified by media at the Site are:

- Soil: cadmium, chromium, copper, lead, manganese, mercury, vanadium, and zinc
- Sediment: copper
- Porewater: aluminum, barium, and iron
- Surface water: barium

The following media-specific contaminants (VOCs and metals) were all retained as COPCs due to a lack of media-specific ESLs.

- Soil: carbazole
- Sediment: barium and vanadium
- Surface water: bromodichloromethane and dibromochloromethane

Based on a comparison of maximum detected concentrations of contaminants in site soil, sediment, surface water, and porewater to conservatively derived Ecological Screening Levels (ESLs), the potential for ecological risk may occur. The chemicals of potential concern (COPCs) identified by media at the Site are:

- Soil: cadmium, chromium, copper, lead, manganese, mercury, vanadium, and zinc
- Sediment: copper
- Surface water: barium
- Porewater: aluminum, barium, and iron

The following media-specific contaminants (VOCs and metals) were all retained as COPCs due to a lack of media-specific ESLs:

- Soil: carbazole
- Sediment: barium and vanadium
- Surface water: bromodichloromethane and dibromochloromethane

COPCs retained via comparison to their respective media-specific ESLs were all comprised of metals and several non-site related VOCs and a pesticide were retained due to a lack of a screening value. However, there were no site-related chemicals (e.g., PCE and DCE) detected in any media evaluated in the SLERA. The compounds detected above conservative ESLs or those that were re-

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tained due to a lack of a screening value are most likely reflective of natural conditions, or non site-related sources. Therefore, the Site poses no site-related risk to ecological communities present.

It is EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered, is necessary to protect public health, welfare and the environment from actual or threatened releases of hazardous substances into the environment.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards, such as applicable or relevant and appropriate requirements (ARARs), to-be-considered guidance, and site-specific risk-based levels.

The RAOs for the Site are:

- Protect human health by preventing exposure via ingestion, inhalation, or dermal contact to contaminated groundwater with concentrations above Preliminary Remediation Goals (PRGs); and
- Remediate the groundwater to the extent practicable by reducing Site contaminant concentrations to PRGs.

The PRGs selected for this Site are:

Contaminant	PRG*
PCE	5 µg/L
cis 1,2-DCE	70 µg/L
1,1-DCE	25 µg/L

*National Primary Drinking Water Standards

Contaminated groundwater is the media of interest for the Site. Surface and subsurface soil samples collected during the RI did not identify a source of site-related VOCs. Site related contaminants are chlorinated volatile organic compounds, including PCE, TCE, cis-1,2-DCE, 1,1-DCE. These contaminants may pose risks to human health through inhalation, ingestion, and dermal contact. Based on the groundwater data collected during the RI, there are three separate plumes at the Site (Figure 3). These three plumes are located in different areas of the Site and have characteristic contaminant profiles. The cis-1,2-DCE plume is located between the PRB Area and the Maunabo #1 public supply well. The PCE plume is located between

the FSM Area and the Maunabo #1 public supply well. The 1,1-DCE plume is located northwest of the Maunabo #4 public supply well. The groundwater plumes are within a designated Wellhead Protection Area and the public supply wells (Maunabo #1 and Maunabo #4) are currently in operation.

Summary of Remedial Alternatives

Remedial alternatives were assembled by combining the retained remedial technologies and process options for each contaminated media. The remedial alternatives to address groundwater contamination in each of the three plumes are summarized below. The proposed remedial alternative for the Site is Alternative 3: *Air Sparging/Soil Vapor Extrusion (cis-1,2-DCE plume) and Monitored Natural Attenuation (PCE and 1,1-DCE plumes)*.

Alternative 1: No Action

The No Action alternative is retained for comparison purposes as required by the NCP. No remedial action would be implemented as part of this alternative. It does not include any institutional controls or monitoring program. Five-year reviews would be conducted by EPA to assess Site conditions. No cost is included in the Feasibility Study for five-year reviews since they would be performed by EPA.

Per CERCLA, alternatives resulting in contaminants remaining above levels that allow for unrestricted use and unlimited exposure require that the Site be reviewed at least once every five years. If justified by the review, additional remedial actions may be implemented to remove, treat, or contain the contamination. The review would include a site-wide visual inspection and a report prepared by EPA.

Alternative 2: Monitored Natural Attenuation

Alternative 2 - Monitored Natural Attenuation (MNA) relies upon naturally occurring destructive mechanisms (biodegradation, dilution, and dispersion) to address the PCE, cis-1,2-DCE and 1,1-DCE plumes. Routine monitoring and contaminant concentration trend analysis are generally performed as part of the MNA response action to demonstrate that contaminants do not represent significant risk and that degradation of the contaminants is occurring. If monitoring indicates that levels are not decreasing sufficiently, a contingency plan would need to be implemented. If asymptotic contaminant concentration

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levels are achieved, an active remedy (e.g., targeted injection, etc.) may be necessary to achieve PRGs.

Alternative 2 consists of the following major activities:

- Pre-design investigation/MNA study
- Institutional controls
- Long-term monitoring
- Five-year review

To help address the uncertainty surrounding contaminant concentration reduction via MNA, an MNA investigation/study would be required in order to provide information to better project the effectiveness of natural attenuation mechanisms at field scale and to confirm that active degradation of contaminants is occurring where needed.

Institutional controls should restrict the future use of the Site and groundwater, and should require precautions to be taken to protect human health in the event remedial measures are disturbed.

Long-term monitoring of Site groundwater can be implemented when contaminants remain above levels that allow for unrestricted use and unlimited exposure. The monitoring program should continue until concentrations have stabilized or meet remedial goals.

According to CERCLA, alternatives resulting in contaminants remaining above levels that allow for unrestricted use and unlimited exposure require that the Site be reviewed at least once every five years. If justified by the review, additional remedial actions may be implemented to remove, treat, or contain the contamination. The review would include a site-wide visual inspection and a report prepared by EPA.

Alternative 3: Air Sparging/Soil Vapor Extrusion (cis-2,2-DCE)) and Monitored Natural Attenuation (PCE and 1,1-DCE Plumes)

Under Alternative 3, Monitored Natural Attenuation (MNA) would be implemented for the PCE and 1,1-DCE plumes as presented in Alternative 2. In addition, under this alternative, Air Sparging (AS) would be used to remove VOCs from the groundwater in the cis-1,2-DCE plume and reduce concentrations to below the PRGs.

Air sparging is a technology in which air is injected into the subsurface through sparge points. The injected air acts to remove or “strip” the VOCs from the groundwater. A grid of sparge points would be installed in areas of

slow moving groundwater—relatively far from the pumping well (Maunabo #1), and a row of sparge points (a sparge curtain) would be installed closer to the well in the faster moving groundwater. Each sparge point is assumed to have a 10-foot radius of influence. This configuration is considered to be cost- and performance-optimized compared to a configuration consisting solely of a grid of sparge points across the entire plume.

A Solid Vapor Extraction (SVE) system will be implemented to collect the VOCs stripped from groundwater by the sparge system. It should be noted that since concentrations in groundwater are low, the mass collected by the SVE system would be very low and potentially below detection limits in the SVE system effluent. Furthermore, biodegradation from the aerobic conditions created by the AS system would further decrease the mass of cis-1,2-DCE and VC to be captured by the SVE.

An air sparging pilot test would be required to determine the radius of influence of each sparge location and soil vapor extraction well, and consequently the number of sparge points needed. The pilot test would also evaluate the need for treatment of the collected vapors.

Data obtained during the RI, pre-design investigation/MNA study, and air sparging pilot test would be used to develop the detailed approach for Site remediation during Remedial Design. All aspects necessary for implementing the remedial action would be considered, including but not limited to: detailed layout of the treatment strategy and system, construction sequence, regulatory requirements, and cost estimates.

It is anticipated that the sparge grid would be operated for one year and the sparge curtain for three years. Performance monitoring would be conducted at groundwater monitoring wells installed in the sparge grid as well as upgradient and downgradient of the sparge curtain.

Pre-design investigation/MNA study, institutional controls, long-term monitoring, and five-year review activities are similar to the described ones in Alternative 2.

Alternative 4: In-situ Bioremediation (cis-1,2-DCE plume) and Monitored Natural Attenuation (PCE and 1,1-DCE plumes)

Under this alternative, in-situ bioremediation could be implemented within the 70 µg/L contour in the cis-1,2-DCE plume, with institutional controls for protection of human health. In the PCE and 1,1-DCE plumes,

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MNA would be relied upon to ensure that the groundwater remediation RAO is met, as described in Alternative 2.

As part of the bioremediation alternative, a microcosm study would be conducted to better understand the natural biological activity within the plume and the effects of amendments on the microbes' ability to reduce contaminant concentrations. The microcosm study would evaluate the effectiveness of an amendment called EHC® and others such as lactate/whey in order to select the most cost-effective amendment(s) for this Site. A pilot study may need to be conducted prior to the remedial design to obtain site-specific design parameters for the full-scale implementation of bioremediation. A pre-design investigation would be conducted to further delineate the vertical and lateral extent of the treatment zone in the plume. In-situ bioremediation of the cis-1,2-DCE plume would be conducted by injecting the selected amendment(s) in the form of bio-barriers, a series of injection points, over the target treatment area, delineated during the pre-design investigation. The amendment can be injected using direct push technology or permanent injection points. Based upon the low concentrations of the contaminants, only one round of amendment injection may be necessary. The reducing conditions created by the amendment injection would potentially enhance natural attenuation of remaining low concentration contaminants in the vicinity of treatment.

In the PCE and 1,1-DCE plumes, MNA would be relied upon to ensure that the groundwater remediation RAO is met, as described in Alternative 2. Institutional controls such as deed restrictions and well drilling restrictions would be implemented to eliminate the exposure pathways of contaminated groundwater to receptors. Long-term monitoring would involve annual groundwater sampling and periodic reviews to monitor and evaluate contaminant migration and concentration changes in the aquifer.

Alternative 4 includes the following components:

- Pre-design investigation
- Microcosm and pilot study
- Remedial Design
- In-situ bioremediation of cis-1,2-DCE plume
- Institutional controls
- Long-term monitoring
- Five-year reviews

According to CERCLA, alternatives resulting in contaminants remaining above levels that allow for unrestricted

THE NINE SUPERFUND EVALUATION CRITERIA

1. Overall Protectiveness of Human Health and the Environment evaluates whether and how an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.

3. Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.

4. Reduction of Toxicity, Mobility, or Volume (TMV) of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

5. Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, the community, and the environment during implementation.

6. Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.

7. Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

8. State/Support Agency Acceptance considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

9. Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

use and unlimited exposure require that the Site be reviewed at least once every five years. If justified by the review, additional remedial actions may be implemented to remove, treat, or contain the contamination. The review would include a site-wide visual inspection and a report prepared by EPA.

Evaluation of Remedial Alternatives

Nine Superfund evaluation criteria are used to evaluate the different remedial alternatives individually and against each other in order to select the best alternative.

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Each alternative has been evaluated against these nine criteria and compared to the other alternatives under consideration. The evaluation of the alternatives in relation to the nine criteria is discussed below. A more detailed analysis of the presented alternatives can be found in the Feasibility Study report.

1. Overall Protection of Human Health and the Environment

Alternative 1 would not meet the RAOs and would not be protective of human health and the environment since no action would be taken. Contamination would remain in the groundwater, while no mechanisms would be implemented to prevent exposure to contaminated groundwater, or to reduce the toxicity, mobility, or volume of contamination except through natural attenuation processes, which would not be monitored to assess the effectiveness or predict the duration of this alternative.

Alternative 2 would meet the RAOs. It is important to note that although historical data in Maunabo #1 has not shown contaminants above the MCLs since 2006, the cis-1,2-DCE plume is within the capture zone of Maunabo #1. If natural attenuation does not occur within a reasonable time frame, there is the potential that the concentrations above the PRGs that are currently present in the plume would enter the Maunabo #1 supply well in the future, potentially impacting human health. Additional data collection would be needed to confirm that concentrations are decreasing through natural attenuation and the PRGs would be met within a reasonable timeframe. Similarly, for the PCE and 1,1-DCE plume, it is uncertain if natural attenuation is occurring at a great enough rate to permanently reduce concentrations to below the PRGs within a reasonable timeframe.

Alternatives 3 and 4 will meet the RAOs. The AS/SVE system for Alternative 3 and the bio-barriers in Alternative 4 would each serve to reduce the concentration of contaminants in groundwater being drawn into the Maunabo #1 supply well, providing protection of human health. Only bio-amendments that are safe to be injected into the aquifer near a public supply well will be considered and further evaluated during the microcosm study. Alternatives 2, 3, and 4 would provide adequate control of risk to human health by implementing institutional and engineering controls.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARRAs)

Alternative 1 would not achieve chemical-specific ARARs established for groundwater. Location and action-specific ARARs do not apply to this alternative since no remedial action would be conducted.

For Alternative 2, further data collection would be needed to confirm the ability of natural attenuation to reduce concentrations and comply with ARARs. If natural attenuation does not occur within a reasonable time frame, ARARs would not be met. This is true also of the PCE and 1,1-DCE plumes for Alternatives 3 and 4. For the cis-1,2-DCE plume, these two alternatives would meet the chemical-specific ARARs over the long-term because implementation of AS/SVE or in-situ treatment processes would significantly reduce contaminant concentrations in the treatment area. There are no location-specific ARARs for this Site. Alternatives 2 through 4 would comply with action-specific ARARs.

3. Long-Term Effectiveness and Permanence

Alternative 1 would not be effective or permanent since there would be no mechanisms to prevent exposure to contaminated groundwater.

Alternative 2 would provide long-term effectiveness and permanence by relying on natural attenuation to permanently reduce contaminant concentrations in the three plumes. However, for the cis-1,2-DCE and 1,1-DCE plumes, it is uncertain if natural attenuation is occurring at a great enough rate to reduce concentrations to below the PRGs within a reasonable timeframe.

Alternatives 3 and 4 differs from Alternative 2 in that these alternatives would provide long-term effectiveness and permanence in the cis-1,2-DCE plumes by using in-situ treatment to reduce the contaminant mass in the treatment area. Alternatives 3 and 4 would provide the greatest permanent mass reduction of contamination within the cis-1,2-DCE plume within the shortest period of time. Remaining low contaminant concentrations in all three plumes would be reduced through natural attenuation processes.

Institutional controls in Alternatives 2, 3 and 4 would prevent exposure to contaminated groundwater while groundwater quality is restored via natural attenuation processes. The long-term effectiveness of the selected alternative would be assessed through routine groundwater monitoring and reviews every five years (five-year review process).

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4. Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1 would not reduce the contaminant toxicity, mobility, or volume (T/M/V) since no remedial action would be conducted.

For Alternative 2, the total volume of contaminated groundwater in all three plumes might increase if natural attenuation processes are unable to contain the plume. The extent and effectiveness of toxicity reduction pathways via natural attenuation, especially ongoing biodegradation of chlorinated contaminants, would need to be verified with further data collection.

Alternatives 3 and 4 would be the most effective in reducing toxicity and volume of contamination through treatment in the cis-1,2-DCE plume. Furthermore, the sparge curtain (Alternative 3) and bio-barriers (Alternative 4) would serve to limit the mobility of the cis-1,2-DCE plume beyond its existing footprint. In the 1,1-DCE plume, mobility would not be reduced via Alternative 3 or 4. However, toxicity and volume will potentially be reduced by biodegradation. T/M/V would not be reduced in the PCE plume since the mechanisms of natural attenuation would be dilution and dispersion, and not biodegradation.

5. Short-Term Effectiveness

With respect to Alternative 1, there would be no short-term impact to the community and environment as no remedial action would occur. For long-term monitoring to be conducted on private property, coordination and access would need to be obtained from private property owners.

There would be short-term impacts to the local community and workers for Alternatives 3 and 4 in the cis-1,2-DCE plume due to the active remedial actions undertaken and associated construction, operation, and/or injection activities. Implementing MNA in the PCE plume and 1,1-DCE plume would not be effective in the short term, since effectiveness would rely upon the dilution and dispersion created by groundwater flow and naturally occurring biodegradation to reduce concentrations to PRGs. Air monitoring, engineering controls, and appropriate worker Personnel Protective Equipment would be used to protect the community and workers for Alternatives 2 through 4.

6. Implementability

Alternative 1 would be easiest both technically and administratively to implement as no additional work would be performed at the Site.

Alternatives 2 through 4 would be technically implementable since services, materials, and experienced vendors would be readily available. Bench and pilot studies would be implemented to obtain Site-specific design parameters. Access agreements would be required to implement the selected alternative on private properties. Permit requirements would have to be met to inject bio-remediation amendment into the subsurface and/or to discharge vapor from an air sparge system to the atmosphere (if required). Overall, Alternative 4 would be the most difficult to implement, followed by Alternative 3, then Alternative 2.

7. Cost

There are no costs associated with Alternative 1. The total present worth for Alternative 2 is \$2.4 million. The total present worth for Alternative 3 is \$4.6 million. The total present worth for Alternative 4 is \$4.5 million.

8. State/Support Agency Acceptance

The Commonwealth of Puerto Rico agrees with the preferred alternative in this Proposed Plan.

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the Responsiveness Summary section of the Record of Decision for this site. The Record of Decision is the document that formalizes the selection of the remedy for a site.

SUMMARY OF THE PREFERRED ALTERNATIVE

Alternative 3: Air Sparging/Soil Vapor Extrusion (cis-1,2-DCE plume) and Monitored-Natural Attenuation (PCE and 1,1-DCE plumes).

Alternative 3 consists of the following major activities:

- Pre-design investigation/MNA study
- AS pilot study
- Remedial design
- AS/SVE installation/operation
- Institutional controls

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- Long-term monitoring
- Five-year reviews

Overall Protection of Human Health and the Environment

This alternative would provide protection of human health and the environment. AS/SVE would remove the contaminants within the cis-1,2-DCE plume permanently; the remaining very low contaminant concentrations are expected to be reduced through natural processes such as dilution, dispersion, and biodegradation.

During remediation, exposure to groundwater in all three plumes—beyond the exposure route of the existing supply wells—would be prevented through institutional controls. This alternative would meet the RAOs. Institutional controls would eliminate the exposure pathway for contaminated groundwater to local receptors before the RAOs and the PRGs are achieved.

Compliance with ARARs

Alternative 3 would not meet chemical-specific ARARs in the short term in the PCE and 1,1-DCE plumes because COC concentrations would continue to exceed the PRGs in groundwater while natural attenuation is taking place. However, over time in all three plumes, the existing concentrations of COCs may decrease to acceptable levels within a reasonable timeframe by either AS/SVE or natural attenuation. If natural attenuation is not proceeding effectively, a contingency remedy would need to be implemented to meet chemical-specific ARARs. This alternative would follow health and safety requirements to meet the action-specific ARARs. There are no location-specific ARARs for this Site.

Long-term Effectiveness and Permanence

AS/SVE would permanently remove contamination by stripping contaminants from groundwater. It is important to note that the proposed configuration of sparge points assumes that Maunabo #1 would continue operating as it currently operates. The sparge curtain layout is proposed in order to harness the hydraulic gradient created by the pumping to draw water into the sparge curtain treatment zone. If the well ceases pumping, the curtain would still be effective, but treatment would take a longer time since the groundwater flow velocity through the curtain would decrease.

An additional factor to consider is aerobic biodegradation. Since volatile compounds and cis-1,2-DCE are known to be degradable by aerobic bacteria, the introduction of oxygen into the aquifer by the sparge system should stimulate the growth of aerobic bacteria capable of degrading these two compounds. Contaminants remaining outside the treatment zone are at low concentrations, and would be reduced over time through dilution and dispersion. Overall, this alternative provides an effective, permanent remedy for the cis-1,2-DCE plume. Natural processes such as dilution, dispersion, and biodegradation would reduce concentrations permanently in the PCE and 1,1-DCE plumes. Institutional controls would prevent exposure to contaminated groundwater before the groundwater quality would be restored to PRGs in each of the three plumes. The long-term monitoring program and five-year reviews would assess the contamination conditions.

Reduction of Toxicity, Mobility, or Volume (T/M/V) Through Treatment

This alternative would significantly reduce the T/M/V of contamination in the cis-1,2-DCE plume. The volume and toxicity of contaminated groundwater would be reduced by the stripping of contamination from groundwater. The mobility of soil vapor would be controlled by the vacuum applied to the treatment area, which would prevent vapor migration. In the 1,1-DCE plume, mobility would not be reduced. However, toxicity and volume will potentially be reduced by biodegradation. T/M/V would not be reduced in the PCE plume since the mechanisms of natural attenuation would be dilution and dispersion, and not biodegradation.

Short-term Effectiveness

This alternative would have some short-term impacts to the community and the environment. AS/SVE would need to be installed and operated on the Site for approximately three years. Installation of the system would be performed without significant risk to the community. Site workers would wear appropriate personal protection equipment (PPE) to minimize exposure to contamination and as protection from physical hazards. AS/SVE will be effective in the short-term. VC and cis-1,2-DCE are volatile compounds that can be stripped relatively effectively from groundwater with sparging. The aerobic conditions in the groundwater created by the sparge system will induce a degree of biodegradation of the contaminants. Implementing MNA in the PCE plume and 1,1-DCE plume would not be effective in the short-term, since effective-

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ness would rely upon the dilution and dispersion created by groundwater flow and naturally occurring biodegradation to reduce concentrations to the PRG.

Implementability

MNA and AS/SVE are well established technologies and could be readily implemented at the Site. This alternative would require the use of readily available conventional construction and subsurface drilling equipment. Groundwater monitoring associated with MNA would be easily implemented using readily available services and materials.

Costs

The total present worth for Alternative 3 is \$4.6 million. The estimated capital cost is \$1.9 million for the first five years, the estimated O&M is \$0.6 million, and monitoring cost is \$2 million for 30 years.

State/Support Agency Acceptance

The Commonwealth of Puerto Rico agrees with the preferred alternative

Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends.

COMMUNITY PARTICIPATION

EPA provided information regarding the cleanup of the Maunabo Groundwater Contamination Site to the public through public meetings, the Administrative Record file for the site and announcements published in the La Esquina and Primera Hora newspapers. EPA encourages the public to gain a more comprehensive understanding of the Site and the Superfund activities that have been conducted there.

For further information including EPA's preferred alternative for the Maunabo Groundwater Contamination Site, contact:

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Or access EPA web page at:

<http://www.epa.gov/region02/superfund/npl/maunabo>

The dates for the public comment period; the date, the location and time of the public meeting; and the locations of the Administrative Record files are provided on the front page of this Proposed Plan.

GLOSSARY

ARARs: Applicable or Relevant and Appropriate Requirements. These are Federal or State environmental rules and regulations that may pertain to the site or a particular alternative.

Carcinogenic Risk: Cancer risks are expressed as a number reflecting the increased chance that a person will develop cancer if exposed to chemicals or substances. For example, EPA's acceptable risk range for Superfund hazardous waste sites is 1×10^{-4} to 1×10^{-6} , meaning there is 1 additional chance in 10,000 (1×10^{-4}) to 1 additional chance in 1 million (1×10^{-6}) that a person will develop cancer if exposed to a Site contaminant that is not remediated.

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act. A Federal law, commonly referred to as the "Superfund" Program, passed in 1980 that provides for response actions at sites found to be contaminated with hazardous substances, pollutants or contaminants that endanger public health and safety or the environment.

COPC: Chemical of Potential Concern.

SLERA: Screening Level Ecological Risk Assessment. An evaluation of the potential risk posed to the environment if remedial activities are not performed at the site.

FS: Feasibility Study. Analysis of the practicability of multiple remedial action options for the site.

Groundwater: Subsurface water that occurs in soils and geologic formations that are fully saturated.

HHRA: Human Health Risk Assessment. An evaluation of the risk posed to human health should remedial activities not be implemented.

HI: Hazard Index. A number indicative of non-carcinogenic health effects that is the ratio of the existing level of exposure to an acceptable level of exposure. A value equal to or less than one indicates that the human population is not likely to experience adverse effects.

HQ: Hazard Quotient. HQs are used to evaluate non-carcinogenic health effects and ecological risks. A value equal to or less than one indicates that the human or ecological population is not likely to experience adverse effects.

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ICs: Institutional Controls. Administrative methods to prevent human exposure to contaminants, such as by restricting the use of groundwater for drinking water purposes.

IEUBK: The Integrated Exposure Uptake Biokinetic Model is a mathematical model that predicts the blood lead concentration in humans due to exposure to lead in air, food, water, dust, and soil. The model can also be used to develop cleanup goals for lead that are protective of public health.

Nine Evaluation Criteria: See text box on Page 7.

Non-carcinogenic Risk: Non-cancer Hazards (or risk) are expressed as a quotient that compares the existing level of exposure to the acceptable level of exposure. There is a level of exposure (the reference dose) below which it is unlikely for even a sensitive population to experience adverse health effects. EPA's threshold level for non-carcinogenic risk at Superfund sites is 1.0, meaning that if the exposure exceeds the threshold; there may be a concern for potential non-cancer effects.

NPL: National Priorities List. A list developed by EPA of uncontrolled hazardous substance release sites in the United States that are considered priorities for long-term remedial evaluation and response.

Operable Unit (OU): a discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration, or eliminates or mitigates a release, threat of a release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site.

Practical Quantitation Level (PQL): means the lowest concentration of a constituent that can be reliably achieved among laboratories within specified limits of precision and accuracy during routine laboratory operating conditions.

Present-Worth Cost: Total cost, in current dollars, of the remedial action. The present-worth cost includes capital costs required to implement the remedial action, as well as the cost of long-term operation, maintenance, and monitoring.

PRG: Preliminary Remediation Goal.

PRPs: Potentially Responsible Parties.

Proposed Plan: A document that presents the preferred remedial alternative and requests public input regarding the proposed cleanup alternative.

Public Comment Period: The time allowed for the members of a potentially affected community to express views and concerns regarding EPA's preferred remedial alternative.

RAOs: Remedial Action Objectives. Objectives of remedial actions that are developed based on contaminated media, contaminants of concern, potential receptors and exposure scenarios, human health and ecological risk assessment, and attainment of regulatory cleanup levels.

Record of Decision (ROD): A legal document that describes the cleanup action or remedy selected for a site, the basis for choosing that remedy, and public comments on the selected remedy.

Remedial Action: A cleanup to address hazardous substances

at a site.

RI: Remedial Investigation. A study of a facility that supports the selection of a remedy where hazardous substances have been disposed or released. The RI identifies the nature and extent of contamination at the facility and analyzes risk associated with COPCs.

Saturated Soils: Soils that are found below the Water Table. These soils stay wet.

TBCs: "To-be-considereds," consists of non-promulgated advisories and/or guidance that were developed by EPA, other federal agencies, or states that may be useful in developing CERCLA remedies.

Unsaturated Soils: Soils that are found above the Water Table. Rain or surface water passes through these soils. These soils remain dry:

EPA: United States Environmental Protection Agency. The Federal agency responsible for administration and enforcement of CERCLA (and other environmental statutes and regulations), and final approval authority for the selected ROD.

VOC: Volatile Organic Compound. Type of chemical that readily vaporizes, often producing a distinguishable odor.

Water Table: The water table is an imaginary line marking the top of the water-saturated area within a rock column.

Figure 1
Site Map

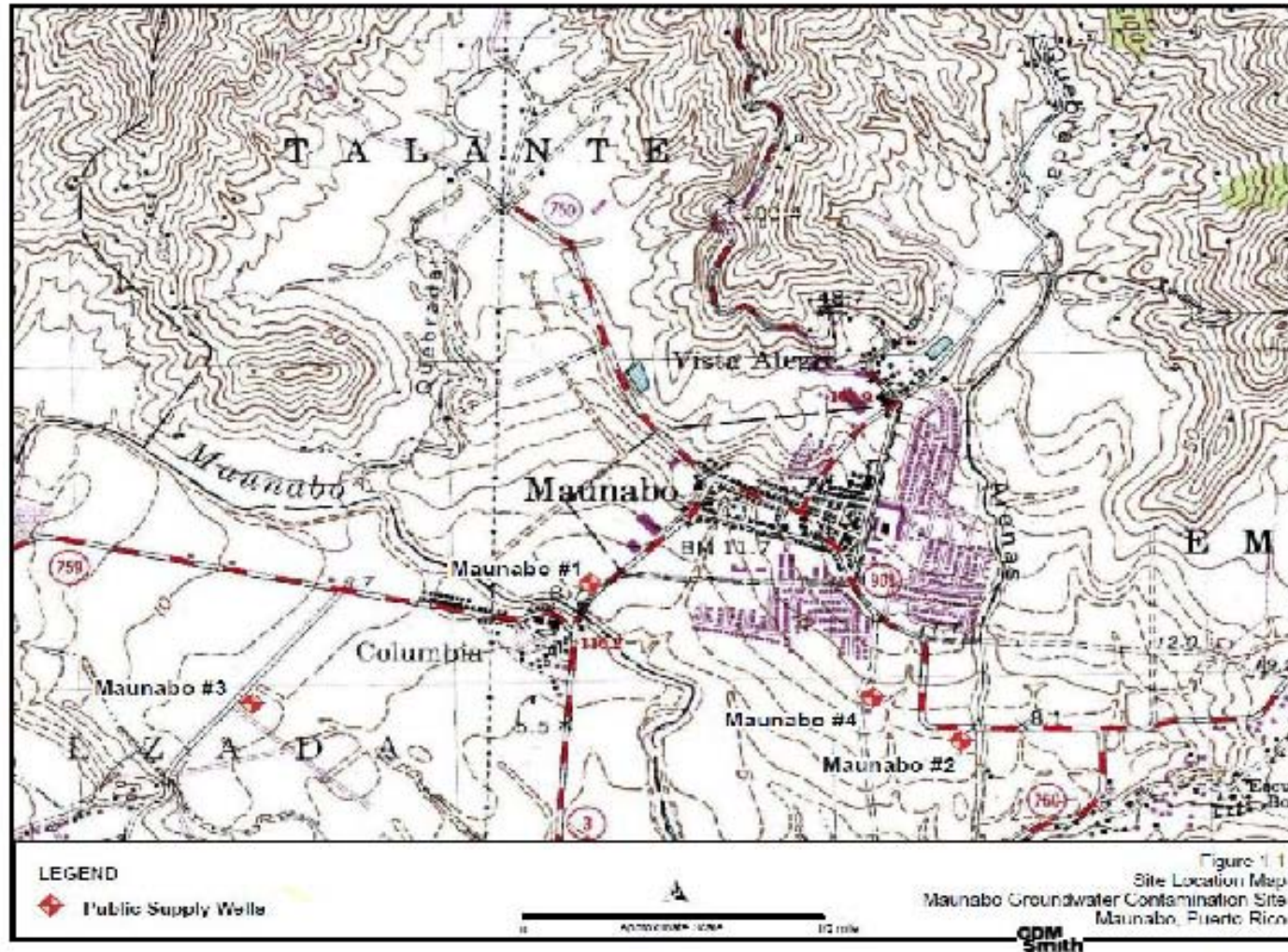
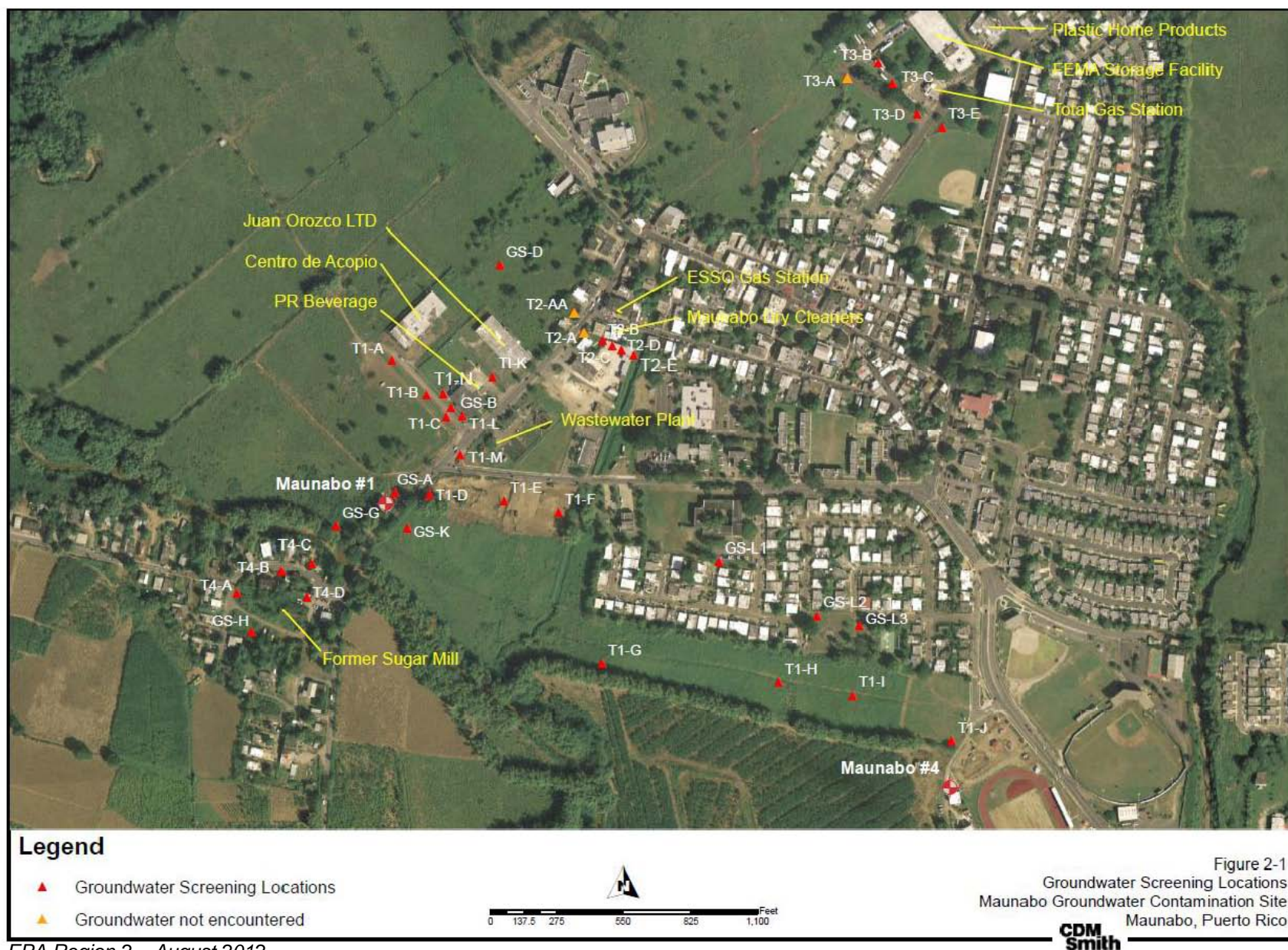


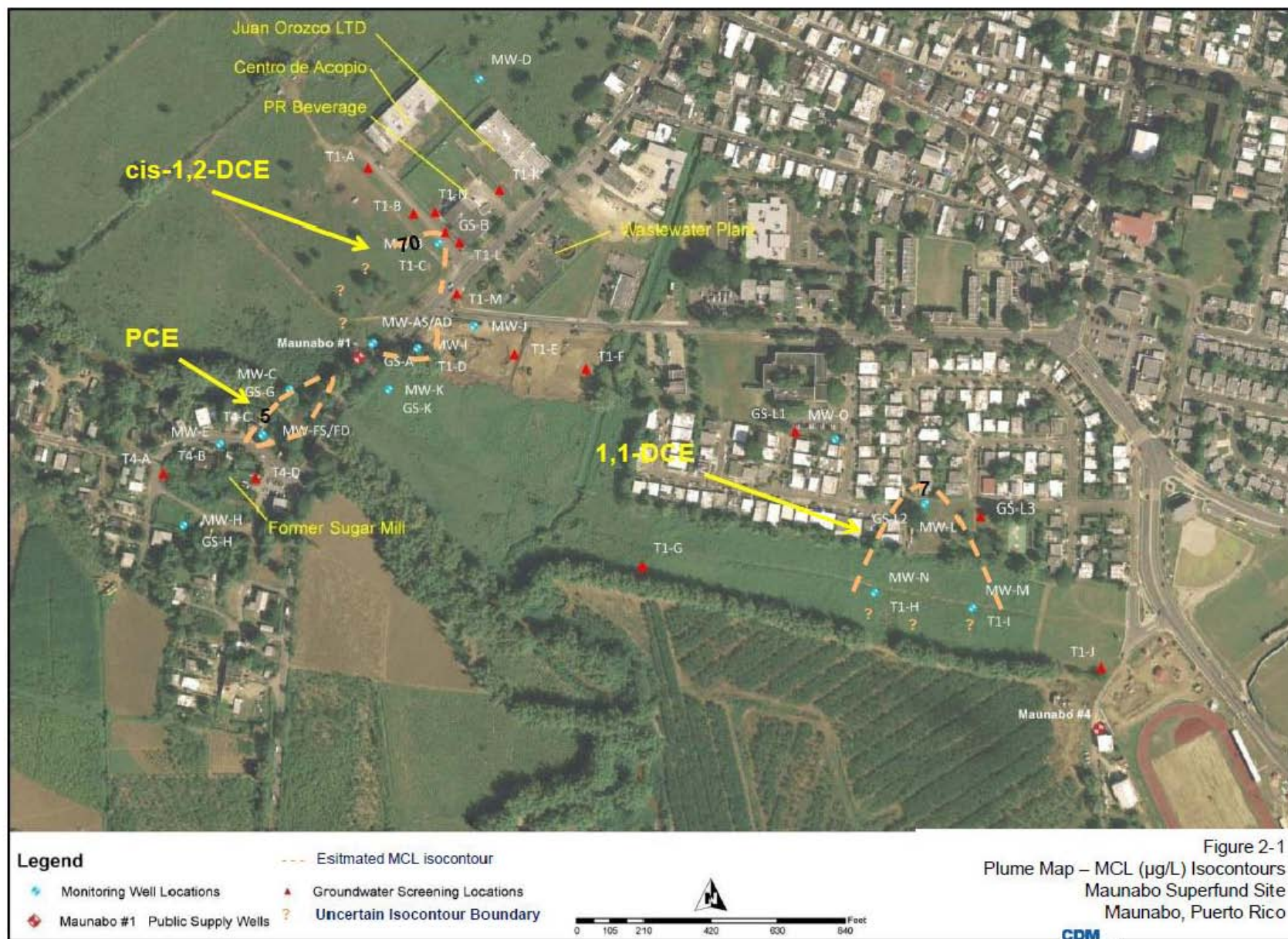
Figure 2
Groundwater Screening Investigation Samples Location



EPA Region 2 – August 2012

R2-0002523

Figure 3
Location of Groundwater Contamination Plume



EPA Region 2 – August 2012

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